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SUPPLEMENTARY MATERIAL

De la Hera *et al*. Habitat distribution by breeding origin in the declining populations of European Robins wintering in southern Iberia.

1) Habitat distribution according to the individual morphology of Robins

Table S1. Distribution between habitats, sites, populations (according to their morphology) and age (adult and juvenile) of the 149 Robins captured during winter in Campo de Gibraltar region. The assignation of the migratory behaviour of Robins is based here on the morphological classification functions (MCF) described in Pérez-Tris et al. (2000). These MCF consider the overall P8 length and the primary distances of the 9 longest primaries (excluding the vestigial outermost primary: P10), the so-called wing formula, for the estimation of the migratory behaviour of Robins. Primary distance was defined as the distance from the tip of each primary to the tip of the longest primary with the wing folded, with a value of zero for the primary (or primaries) constituting the wingtip. To facilitate the comparison between the morphological and isotopic methods of population differentiation, we also provided in brackets the distribution of Robins based on the δD_f values (see Table 1 in the manuscript).

	Migratory Robins		Sedentary Robins		
Sites	Adults	Juveniles	Adults	Juveniles	Total
Woodlands					
San Carlos Carretera	6 (11)	5 (13)	17 (12)	12 (4)	40
San Carlos Tiradero	7 (7)	9 (15)	14 (14)	13 (7)	43
Shrublands					
Almodóvar	10 (17)	5 (17)	7 (0)	13 (1)	35
Betis	8 (14)	3 (16)	7 (1)	13 (0)	31

2) Estimating wing shape parameters in wintering Robins

We used transformed values of the primary distances described above to estimate the variation in the wing shape of Robins wintering in Campo de Gibraltar region. For this purpose, we opted for transforming primary distances (P1-P9) into distances from the carpal joint (cP1-cP9) by subtracting, for each primary, its primary distance from the wing length. These transformed distances (cP1-cP9) were then standardized according to the method suggested by Senar et al. (1994), which provides more reliable measurements (cP1*-cP9*) that correct for the among-individual variation in wing size. These standardized values were used in a Principal Component Analysis (PCA) that gave rise to two principal components (KMO = 0.77; Bartlett's test of sphericity: χ^2_{36} = 857.9, P < 0.001). PC1* was interpreted as an index of wing concavity (eigenvalue = 4.07; explained variance = 0.45; factor loadings: cP9* = 0.17, cP8* = 0.19, cP7* = 0.17, cP6* = -0.12 , cP5* = -0.37 , cP4* = -0.44, cP3* = -0.45, cP2* = -0.44, cP1* = -0.40); while PC2* reflected variation in wingtip shape (eigenvalue = 1.97; explained variance = 0.22; factor loadings: cP9* = 0.52, cP8* = 0.58, cP7* = 0.50, cP6* = -0.16, cP5* = 0.03, cP4* = 0.12, cP3* = 0.16, cP2* = 0.20, cP1* = 0.20).

Senar, J.C., Lleonart, J. & Metcalfe, N.B. 1994. Wing-shape variation between resident and transient wintering siskins *Carduelis spinus*. J. Avian Biol. **25**: 50–54.

3) Bird morphology and its relationship with δD_f values in migrants.

We explored the relationship of the development of flight morphology (PC1), structural size (PC2), wing concavity (PC1*) and wingtip shape (PC2*) with δD_f in the 110 migratory Robins wintering in Campo de Gibraltar. For this purpose, we performed Linear Mixed Models that analysed these variables (PC1, PC2, PC1* and PC2*) in relation to age, sex and their interaction as fixed effects, δD_f as continuous predictor, and year as a random effects factor. Results for each morphological trait are shown below:

a. Results for the analysis of the development of flight morphology (PC1)

```
Random effects:
 Formula: ~1 | year
        (Intercept) Residual
StdDev:   0.3351773 1.153982

Fixed effects: PC1 ~ 1 + age + sex + age:sex + isot
                    Value Std.Error  DF   t-value p-value
(Intercept)     0.6110034 0.6019319 104  1.015071  0.3124
agejuv         -0.5651009 0.2733171 104 -2.067566  0.0412
sexmale         2.2143418 0.3550023 104  6.237541  0.0000
isot            0.0103854 0.0071875 104  1.444938  0.1515
agejuv:sexmale  0.0911411 0.4706501 104  0.193649  0.8468
```

b. Results for the analysis of structural size (PC2)

```
Random effects:
 Formula: ~1 | year
        (Intercept)  Residual
StdDev:    0.222351 0.9446133

Fixed effects: PC2 ~ 1 + age + sex + age:sex + isot
                    Value Std.Error  DF   t-value p-value
(Intercept)     1.4898703 0.4792318 104  3.108872  0.0024
agejuv         -0.1738395 0.2236716 104 -0.777209  0.4388
sexmale        -0.2334712 0.2904189 104 -0.803912  0.4233
isot            0.0210896 0.0058831 104  3.584750  0.0005
agejuv:sexmale -0.0651280 0.3852394 104 -0.169059  0.8661
```

c. Results for the analysis of wing concavity (PC1*)

```
Random effects:
 Formula: ~1 | year
         (Intercept) Residual
StdDev: 7.861797e-05  1.88228

Fixed effects: PC3 ~ 1 + age + sex + age:sex + isot
                    Value Std.Error  DF    t-value p-value
(Intercept)    -2.0649240 0.8977056 104 -2.3002241  0.0234
agejuv          0.3885365 0.4445330 104  0.8740331  0.3841
sexmale         0.4612881 0.5751271 104  0.8020629  0.4243
isot           -0.0332648 0.0117174 104 -2.8389206  0.0054
agejuv:sexmale -0.9298825 0.7672414 104 -1.2119817  0.2283
```

d. Results for the analysis of wingtip shape (PC2*)

```
Random effects:
 Formula: ~1 | year
        (Intercept) Residual
StdDev:  0.06590182 1.168917

Fixed effects: PC4 ~ 1 + age + sex + age:sex + isot
                    Value Std.Error  DF    t-value p-value
(Intercept)     0.5434921 0.5599454 104  0.9706162  0.3340
agejuv          0.7984189 0.2761976 104  2.8907520  0.0047
sexmale        -0.5395059 0.3575834 104 -1.5087555  0.1344
isot            0.0096474 0.0072773 104  1.3256870  0.1878
agejuv:sexmale  0.4430462 0.4765132 104  0.9297670  0.3546
```

4) Variation between habitats in the morphological characteristics of migratory Robins.

We tested for differences between habitats (shrublands vs. woodlands) in the development of flight morphology (PC1), structural size (PC2), wing concavity (PC1*) and wingtip shape (PC2*) in the 110 migratory Robins wintering in Campo de Gibraltar. For this purpose, we performed Linear Mixed Models that analysed these variables (PC1, PC2, PC1* and PC2*) in relation to age, sex, habitat and their two-way interaction as fixed effects, and year as a random effect factor. Results for each morphological trait are shown below:

a. Results for the analysis of the development of flight morphology (PC1)

```
Random effects:
 Formula: ~1 | year
        (Intercept) Residual
StdDev:   0.2837229 1.165277

Fixed effects: PC1 ~ 1 + age + sex + habitat + age:sex + age:habitat +
sex:habitat
                         Value Std.Error  DF   t-value p-value
(Intercept)          -0.2459673 0.3172294 102 -0.775361  0.4399
agejuv               -0.5399119 0.3287123 102 -1.642506  0.1036
sexmale               2.2172294 0.3971552 102  5.582779  0.0000
habitatwoods          0.3647179 0.3869094 102  0.942644  0.3481
agejuv:sexmale        0.0185935 0.4786796 102  0.038843  0.9691
agejuv:habitatwoods  -0.0456698 0.4580340 102 -0.099708  0.9208
sexmale:habitatwoods  0.0424203 0.4856511 102  0.087347  0.9306
```

b. Results for the analysis of structural size (PC2)

```
Random effects:
 Formula: ~1 | year
        (Intercept)  Residual
StdDev:    0.208793 0.9857652

Fixed effects: PC2 ~ 1 + age + sex + habitat + age:sex + age:habitat +
sex:habitat
                         Value Std.Error  DF    t-value p-value
(Intercept)          -0.0693375 0.2549520 102 -0.2719629  0.7862
agejuv               -0.1322375 0.2780068 102 -0.4756629  0.6353
sexmale              -0.3574871 0.3359634 102 -1.0640654  0.2898
habitatwoods          0.1660262 0.3268262 102  0.5079955  0.6126
agejuv:sexmale       -0.2513887 0.4049097 102 -0.6208513  0.5361
agejuv:habitatwoods   0.0450224 0.3874730 102  0.1161950  0.9077
sexmale:habitatwoods  0.5243292 0.4103784 102  1.2776723  0.2043
```

c. Results for the analysis of wing concavity (PC1*)

```
Random effects:
 Formula: ~1 | year
         (Intercept) Residual
StdDev: 8.372387e-05  1.91513
```

```
Fixed effects: PC3 ~ 1 + age + sex + habitat + age:sex + age:habitat +
sex:habitat
                         Value Std.Error  DF    t-value p-value
(Intercept)           0.5157192 0.4032550 102  1.2788909  0.2038
agejuv                0.0345225 0.5385727 102  0.0641000  0.9490
sexmale               0.8177916 0.6524814 102  1.2533562  0.2129
habitatwoods         -0.5718823 0.6239014 102 -0.9166229  0.3615
agejuv:sexmale       -0.6104467 0.7859893 102 -0.7766603  0.4392
agejuv:habitatwoods   0.6424007 0.7527642 102  0.8533890  0.3954
sexmale:habitatwoods -1.2695223 0.7867493 102 -1.6136301  0.1097
```

d. Results for the analysis of wingtip shape (PC2*)

```
Random effects:
 Formula: ~1 | year
        (Intercept) Residual
StdDev: 5.203198e-05 1.134659

Fixed effects: PC4 ~ 1 + age + sex + habitat + age:sex + age:habitat +
sex:habitat
                         Value Std.Error  DF    t-value p-value
(Intercept)          -0.4735655 0.2389170 102 -1.9821345  0.0502
agejuv                1.0008093 0.3190888 102  3.1364604  0.0022
sexmale              -0.5688229 0.3865764 102 -1.4714371  0.1443
habitatwoods          0.9235074 0.3696436 102  2.4983727  0.0141
agejuv:sexmale        0.3570352 0.4656760 102  0.7667031  0.4450
agejuv:habitatwoods  -0.5383149 0.4459910 102 -1.2070084  0.2302
sexmale:habitatwoods  0.1293235 0.4661262 102  0.2774430  0.7820
```